NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

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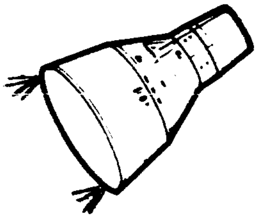

PROJECT: GEMINI 9 N66 28552

(To be launched no earlier than May 17)

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GEMINI 9

LAUNCHES

SET MAY 17

The National Aeronautics and Space Administration will launch the Gemini 9 spacecraft and its Agena Target Vehicle no earlier than May 17 from Cape Kennedy, Fla.

Objectives of the mission are rendezvous and docking of the Gemini with the Agena and extravehicular activity by the pilot. Launch of the Agena is scheduled for 10 a.m. (EST) with the Gemini to lift off at 11:39:09 a.m. (EST).

Command pilot for the three-day Gemini flight is Astronaut Thomas P. Stafford. Pilot is Eugene A. Cernan. Backup crew is James A. Lovell, Jr., command pilot, and Edwin E. Aldrin, pilot.

Stafford was pilot on the Gemini 6 mission which accomplished the first space rendezvous. Gemini 9 will be Cernan's first space flight.

Lovell was pilot on the 14-day Gemini 7 mission which served as the rendezvous target for Gemini 6. Aldrin has not yet made a space flight.

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Stafford is an Air Force lieutenant colonel, Cernan a Navy lieutenant commander, Lovell a Navy captain and Aldrin a major in the Air Force.

The Agena will be launched by an Atlas booster developing 390,000 pounds of thrust. The Gemini launch vehicle is the 430,000-pounds-thrust Titan II rocket.

The Agena will be inserted into a 185-statute-mile circular orbit and Gemini 9 will be placed in an initial 100-by-168-mile orbit. Rendezvous is scheduled for the third revolution approximately four hours after the Gemini launch.

About 30 minutes after rendezvous Gemini 9 will dock with the Agena over Hawaii. A bending test (Study of amount of bending - the two vehicles undergo when they are joined) and a redocking by the pilot will be made before the crew powers down the spacecraft for an eight-hour rest period.

Cernan will begin his extravehicular activity near the end of the 13th revolution and he will be out of the spacecraft about two hours and 25 minutes.

During the first daylight portion of the extravehicular activity, Cernan will remain on a 25-foot umbilical tether with oxygen supplied from the spacecraft. He will retrieve a meteoroid collection experiment from the Gemini adapter (an inpressurized ring at the Gemini's aft end) and expose some new surfaces on another meteoroid collection experiment on the Agena.

He will evaluate tether dynamics of the 25-foot umbilical and evaluate the handrail and handholds on the Gemini adapter section.

During the night pass Cernan will be in the adapter section where he will strap on the Astronaut Maneuvering Unit (AMU), a backpack with a propulsion unit and oxygen supply.

At the next sunrise, Stafford will undock the Gemini from the Agena and move 120 feet behind the target vehicle. Cernan will move to the front of the Gemini and test the control and translation characteristics of the AMU. Working on a 125-foot tether, Cernan may move to the undocked Agena before reentering the Gemini.

After the space walk and a third redocking, the remainder of the flight will include three burns of the Agena primary propulsion system while docked with Gemini, two re-rendezvous of Gemini with the Agena and one firing of the Agena secondary propulsion system while docked.

The two re-rendezvous operations are:

1. An "equi-period" one in which two spacecraft orbit the Earth in the same total time but on different apogee and perigee. This test, originally planned for the Gemini 8 mission, will be made using only the onboard computer and optical equipment, but not the radar;

2. A simulated Lunar Excursion Module abort rendezvous, the terminal phase beginning with the Gemini spacecraft above and in front of the Agena.

Seven experiments are scheduled for the mission. Scientific experiments include zodiacal photography, two meteoroid collection experiments, and airglow horizon photography. Technological experiments are UHF/VHF polarization and the Astronaut Maneuvering Unit. The medical experiment is the bioassays of body fluids.

Gemini 9 is scheduled to land in the West Atlantic Ocean about 345 miles east of Cape Kennedy at the beginning of the 45th revolution after some 70 hours and 50 minutes of flight.

END OF GENERAL RELEASE

(Background Information Follows)

PREFLIGHT ACTIVITIES AND INTEGRATED COUNTDOWN

Gemini flights are developed by the NASA Manned Spacecraft Center (MSC), Houston, Texas, under the direction of the NASA Headquarters Office of Manned Space Flight in Washington, D.C. The NASA John F. Kennedy Space Center (KSC), Fla., has the overall responsibility for pre-flight testing, checkout and launching of the Gemini and Atlas/Agena vehicles for the Gemini 9 mission. After launch, control of the flight is the responsibility of the Mission Control Center, MSC.

The Gemini 9 launch vehicle (GLV) was shipped to KSC with the first stage arriving March 8 and the second stage March 10. Both stages were erected at Launch Complex 19, Cape Kennedy March 24. The Gemini 9 spacecraft was flown to KSC from St. Louis March 2. It was taken to the pyrotechnic installation building, Merritt Island, for receiving inspection, ordnance installation and assembly checks. The rendezvous and recovery section and reentry control section of the spacecraft were mated, and the "premate buildup" was completed with installation of the pilot ejection seats, seat pyrotechnics and parachutes.

The modified Atlas booster for the target vehicle, known as a standard launch vehicle (SLV) arrived at KSC Feb. 13. The Gemini Agena Target Vehicle (GATV) and its docking adapter arrived at KSC March 12.

The Agena, docking adapter and the Gemini spacecraft were mounted atop a 50-foot "timber tower" at KSC's Radio Frequency Test Systems site March 23. The prime Gemini 9 crew and their backups boarded the spacecraft on the tower to conduct a series of radio frequency capability tests between Gemini 9 and the Agena target. Docking compatibility checks also were made between the two vehicles. The spacecraft was transported to Launch Complex 19 March 28 and hoisted above the launch vehicle. Following a series of premate verifications tests, which included a simulated flight to verify spacecraft systems, the Gemini 9 was electrically mated to its Titan II rocket April 13.

The launch crew then conducted about two weeks of individual and combined tests of the spacecraft and launch vehicle to insure that all systems were ready for flight. The pilots participated in their space suits. Mechanical mating of the Atlas booster and the Agena was scheduled for May 4. Combined interface and joint systems tests were conducted with the complete vehicle. A simultaneous countdown -- a complete dress rehearsal -- was scheduled for May 10.

The Gemini 9 count actually is a combination of nine different countdowns, mostly running simultaneously. The different counts are associated with the two launch vehicles, the two spacecraft, crew, Houston Mission Control and the worldwide tracking network, the Eastern Test Range and the Radio-Command Guidance System.

Timing is critical in this count to complete the rendezvous. In the final countdown on launch day, the Atlas Agena count starts at T-530 minutes, the spacecraft at T-360 minutes, and the Gemini launch vehicle joins the combined count at 240 minutes (all these times are set in relation to the GLV liftoff).

Liftoff for the target vehicle is scheduled for the 95-minute mark in the simultaneous count. The Gemini spacecraft will be launched approximately 99 minutes later, depending on the exact location and performance of the orbiting Agena. A built-in hold is scheduled at T-3 minutes to adjust the Gemini liftoff time to coincide with the Agena target's first pass over the Cape. After the launch sequence adjustments are computed, the count will resume.

LAUNCH VEHICLE COUNTDOWN

Time	Gemini	Atlas-Agena
F-3 days..........	Start pre-count............	Countdown
F-1 day...........	Start mid-count	
T-720 minutes.....	GLV propellant loading	
T-530 minutes..		Begin terminal count
T-390 minutes.....	Complete propellant loading	
T-300 minutes.....	Back-up flight crew reports to the 100-foot level of the White Room to participate in final flight preparation. Begin terminal countdown Pilots' ready room, 100-foot level of White Room and crew quarters manned and made ready for prime crew.	
T-285 minutes.....	Primary crew awakened	
T-255 minutes.....	Medical examination	
T-240 minutes..		Start tower removal
T-235 minutes.....	Breakfast	
T-195 minutes.....	Crew leaves quarters	
T-185 minutes.....	Crew arrives at ready room on Pad 16	
T-135 minutes.....	Purging of suit begins	

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T-124 minutes.....	Crew leaves ready room	
T-120 minutes.....	Flight crew to Complex 19	
T-119 minutes.....	Crew arrives at 100-foot level	
T-115 minutes.....	Crew enters spacecraft	
T-100 minutes.....	Close spacecraft hatches	
T-95 minutes..................................		**Lift off**
T-86 minutes..................................		**Insertion into orbit**
T-70 minutes......	White Room evacuation	
T-55 minutes......	Begin erector lowering	
T-20 minutes......	Spacecraft OAMS static firing	
T-3 minutes.......	Built-in hold	
T-03 seconds......	GLV ignition	
T-0 seconds.......	Lift off	
T+2 minutes 36.... seconds	Booster engine cutoff (BECO)	
T+5:41............	Second stage engine cutoff (SECO)	
T+5:57............	Spacecraft-launch vehicle separation	
T+6:07............	Insertion into orbit	

REENTRY

(Elapsed Time from Gemini Lift-Off)

70:12.............	Retrofire
70:12.............	Jettison retrograde section
70:26.............	400,000 feet altitude
70:28.............	Communications blackout
70:31.............	Initiate guidance
70:32.............	Blackout ended
70:34.............	Drogue chute deployed (50,000 feet)
70:36.............	Main chute fully deployed (9,800 feet)
70:40.............	Spacecraft landing

MISSION DESCRIPTION

Mission information presented in this press kit is based on a normal mission. Plans may be altered prior to or during flight to meet changing conditions.

All orbital parameters are given in statute miles. For nautical miles multiply by .87. For kilometers multiply by 1.61.

LAUNCH

Launch Times -- Atlas-Agena - 10 a.m. EST, Launch Complex 14. Gemini 9 - 11:39:08 a.m. EST, Launch Complex 19.

Launch Window -- Begins approximately 99 minutes after the Agena launch and lasts for six and one-quarter minutes on the first day. If the Gemini is not launched during this window on the first day, rendezvous may be achieved by launching during varying windows on the following four days. The windows on these days vary according to the Agena orbit but, under planned conditions, they last for approximately 47 minutes.

Azimuth -- Atlas-Agena launch is biased from 83.7 to about 84.4 degrees to provide for yaw steering during Atlas sustainer burn in order to shift orbital equatorial nodes or crossings..2 degrees to east. Gemini launch vehicle launch azimuth will be 97.8 degrees, but will be biased slightly so that a small amount of yaw steering during the second-stage burn will place the spacecraft in the plane of Agena.

Out-of-Plane Capability -- Fuel budget allows spacecraft to maneuver one-half of one degree out-of-plane if the booster yaw steering does not place Gemini in the correct plane. Corrections of greater magnitude must be performed by the Agena which is capable of about 10 degrees of out-of-plane maneuvering.

Inclination -- 28.87 degrees for both Agena and Gemini spacecraft.

RENDEZVOUS
(All times are approximate)

Orbits -- Agena at near-circular 185 miles. Gemini initially in elliptical 100-168 miles. Gemini trails Agena by 720 miles at insertion.

Incremental Velocity Adjustment Routine (IVAR) -- At spacecraft insertion a burn may be made if the insertion parameters do not match the desired velocity. The maneuver will be made only if the spacecraft underspeed increment is no more than 30-feet-per-second. If the spacecraft is overspeed or if the underspeed velocity difference is more than 30 feet-per-second (fps). The IVAR will not be performed, but a separation maneuver of at least five fps will be made. Aft firing thrusters are used throughout.

Phase Adjustment -- Near spacecraft first apogee, at a ground elapsed time (GET) of 50 minutes (00.50), a posigrade horizontal burn (normally 53.4 fps) will raise the perigee to about 134 miles. This will reduce the catch-up rate from about 6.68 degrees to 4.51 degrees per orbit and provide necessary phase relation at second apogee. Gemini trails Agena at this point by 480 miles.

Combination Correction Maneuver -- This is designed to adjust spacecraft catch-up rate, altitude and to bring Gemini closer to the Agena orbit plane. Executed at 1 hour 57 minutes GET (01:57) at the beginning of the second revolution over Ascension, it is a normal 0.8 fps burn, but can vary according to dispersions. In Gemini 9 the altitude between Gemini and Agena will be allowed to vary five miles plus-or-minus from the normal 15-mile difference in altitude to give control over the exact rendezvous point. Gemini trails Agena by 205 miles.

Co-elliptical Maneuver -- Near the second spacecraft apogee at 2 hours 20 minutes (02:20) GET, the crew will circularize the orbit to 168 miles. It will be a posigrade maneuver of 52.9 fps with spacecraft pitched up four degrees. At this time, the spacecraft trails the Agena by 154 miles and should have onboard radar lock-on.

Terminal Phase Maneuver -- At 2 hours 24 minutes (02:24) GET the crew will switch the computer to rendezvous mode and begin terminal phase system checkout and procedures. At 3 hours 27 minutes (03:27) GET, about three minutes prior to entering darkness, the crew will perform a burn of 32.4 fps along line of sight to the Agena. Distance from the Agena will be about 37 miles and spacecraft will be 130 degrees of angular orbit travel from the point of rendezvous. The spacecraft will be pitched up 27 degrees for this posigrade maneuver using aft thrusters.

Intermediate Corrections -- Twelve minutes after initial impulse, the computer displays the first correction to be applied by the crew. It is a 3 fps maneuver performed at 03:39 GET. Twelve minutes later, at 3 hours, 51 minutes, (03:51) GET another correction is applied. Range is about 4.5 miles and the crew begins a semi-optical approach to the Agena. The crew will use radar information directly to read out range and range rate.

Velocity Matching Maneuver -- The magnitude of a theoretical velocity-matching maneuver at 3 hours 59 minutes (03:59) GET is about 42 fps. However, since the command pilot will be controlling final approach by semi-optical techniques, he will make real-time decisions. Rendezvous should occur over the Indian Ocean northwest of Australia.

DOCKING OPERATIONS

When the spacecraft comes within 50 feet of the Agena, it will stop its relative motion and fly formation with the target vehicle for approximately 30 minutes before the first docking over Hawaii. No further operations will be performed with the Agena until the next pass over Hawaii, when a bending mode test is scheduled for 6 hours (06:00) GET. The Gemini propulsion system is used to set up small rates in pitch and yaw to check the interface between the Gemini and the Agena docking adapter. The Gemini will undock from the Agena at approximately 6 hours 30 minutes (06:30) GET and the pilot will perform a docking operation. After an eat period, the crew will power down the spacecraft for an eight-hour rest period,

EXTRAVEHICULAR ACTIVITY

At the 17th hour after liftoff, the crew will prepare for the pilot's extravehicular activity. The extravehicular life support system (ELSS) chest pack (see Crew Provisions section for details) will be unstowed, along with the 25-foot umbilical tether and "Y" connectors. The pilot makes the connections between the 25-foot umbilical and the chest pack and his Extra-Vehicular Activity (EVA) suit. The command pilot will lower cabin pressure to 3.5 pounds per-square-inch for a systems check and then completely depressurize the cabin. The pilot is scheduled to open the hatch at 20 hours 51 minutes GET, (10 minutes after sunrise) at the end of the 13th revolution and leave the spacecraft.

On the first daylight pass over the United States, the pilot will perform the following tasks:

While standing on the seat he will mount the extravehicular motion picture camera facing forward, then retrieve the S-12 micrometeroid experiment on the retro adapter directly behind his seat. He will then move to the target docking adapter and open the S-10 micrometeroid experiment mounted there. He will evaluate tether dynamics using the 25-foot umbilical and then move to the adapter section to evaluate the handrail and velcro (tape) handholds for surface transit. He goes to the rear of the adapter section to inspect the D-12 Astronaut Maneuvering Unit (AMU) and will cut away any debris which may be attached to the adapter section.

Prior to sunset he moves into position on the adapter foot and hand bars in the adapter to begin putting on the AMU.

During the night pass the pilot will stay in the adapter section, putting on the AMU. Immediately before the second day pass, the command pilot will undock the Gemini from the Agena and fly 120 feet in plane behind the Agena. He will then fire the pyrotechnics to free the AMU from the adapter section and the pilot will move to the nose of the spacecraft. Using the 125-foot mechanical tether, he will move approximately 40 feet from the nose of the spacecraft. He will evaluate the AMU attitude control system by making small movements in pitch and yaw. He will then make small translations, no more than one-half-foot-per-second. Both maneuvers will be made with and without the automatic stabilization feature of the AMU.

When these maneuvers have been completed, the command pilot will maneuver the spacecraft to simulate a pickup of the EVA pilot. The EVA crewman then uses the AMU to translate to the Agena and maneuver in the vicinity of the Agena. He moves back to the spacecraft, reconnects to the spacecraft 25-foot umbilical, and jettisons the AMU.

The EVA pilot will not reenter the spacecraft until after the beginning of the second night pass. After sunset, the pilot will take dimlight photography for the S-1 experiment while standing in the seat. He will make final ingress and close the hatch at approximately 23 hours 17 minutes, a total of 2 hours and 25 minutes outside the spacecraft.

DOCKED PRIMARY PROPULSION MANEUVERS

Three maneuvers using the 16,000-pound thrust Agena primary propulsion engine while the Gemini is docked with the Agena are scheduled for the mission. Each burns will provide 104 fps. The first two maneuvers will be commanded and controlled by the crew and the final maneuver will be loaded with a stored program command (SPC) from the ground. The firings will exercise the capability of the Agena to be used as a propulsion system for orbital maneuvers by the Gemini. In a later Gemini flight, it is planned to use the primary mission Agena to propel the Gemini spacecraft to a re-rendezvous with one of the passive Agenas left in a parking orbit from an earlier flight.

The maneuvers for the Gemini 9 mission include:

Out-of-plane -- Takes place at 26 hours and 59 minutes (26:59) GET over Hawaii in the 17th revolution. The Gemini-Agena vehicle will be yawed around to the target docking adapter north position. The burn will have no effect on the inclination since it will be done at maximum spacecraft orbital latitude. The resulting orbit will be 185 by 186 miles.

Posigrade, in plane -- At 40 hours and 28 minutes (40:28) GET the second burn will be made in the 26th revolution over the Canary Islands. The resulting orbit will have a 185-mile perigee and a 255-mile apogee.

Retrograde, in plane -- At 43 hours 30 minutes (43:30) GET the final burn will be made at the beginning of the 28th revolution over Antigua and will result in a 182 by 190-mile orbit for the two spacecraft.

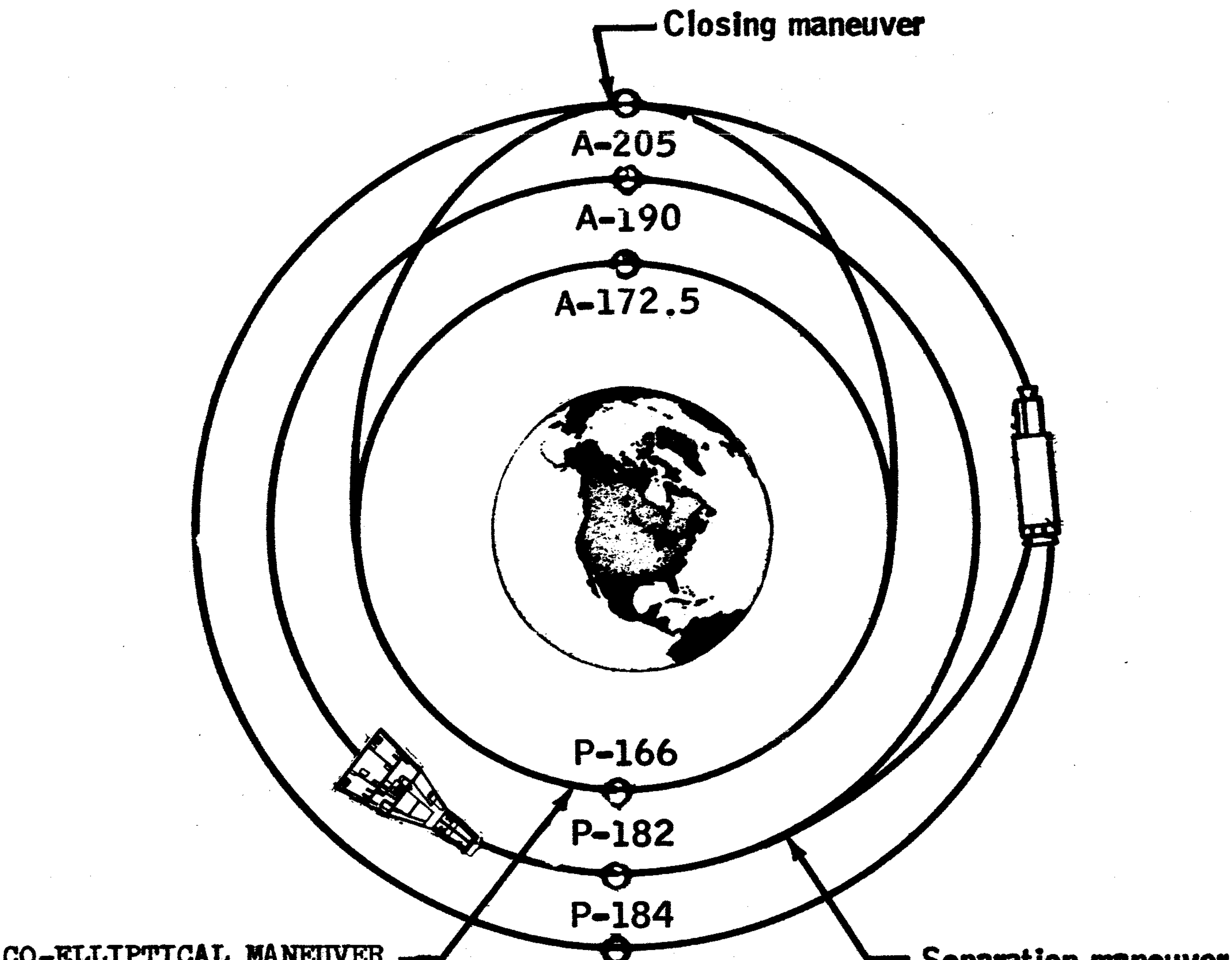
EQUIPERIOD RE-RENDEZVOUS

At 45 hours into the flight, the crew will begin preparation for the first of two planned re-rendezvous maneuvers. The equiperiod re-rendezvous is the same type of maneuver which had been planned for Gemini 8. It will be a completely onboard operation using the computer and a hand-held sextant to obtain guidance information. The purpose of this re-rendezvous is to simulate the terminal phase of a passive target rendezvous which will be performed on a later Gemini mission. The radar will not be used except as a backup if visual contact is lost with the target.

At 45 hours 34 minutes (45:34) GET in the 29th revolution over Tananarive, the Gemini spacecraft will perform an upward radial translation of 20 fps. The new orbit will be equiperiod with the Agena orbit, i.e.; the perigee and apogee points of the two orbits do not coincide, but the orbital period is the same. Gemini will have a perigee of 179 miles and an apogee of 192 miles.

The spacecraft will travel above and behind the Agena into sunset. The maximum separation distance will be 13 miles behind the Agena. A mid-course correction may be made if necessary.

At 46 hours and 47 minutes (46:47) GET, the terminal phase initiation will begin. A 1.9 fps burn retrograde will be made to put the spacecraft on an 80-degree intercept, i.e.; rendezvous will occur 80 degrees around the Earth from that point. The pilots will be in a heads-down attitude to shield the spacecraft windows from direct sunlight. The target must be visually acquired to perform terminal phase maneuvers.



A = Apogee
P = Perigee

(Lunar abort)

Gemini 9 re-rendezvous

Line of sight elevation and sun-angle time histories will be scaled for a passive rendezvous, so that the side of the Agena toward the spacecraft is illuminated. Range and range rate will be scaled at 40 per cent.

At 47 hours 6 minutes 55 seconds (47:07) GET the velocity match maneuver of 16 fps is made to bring the spacecraft back to a 182 by 191 mile orbit. Docking should be completed over the Tananarive tracking station at 47 hours 12 minutes (47:12) GET.

SIMULATED LUNAR EXCURSION MODULE ABORT RE-RENDEZVOUS

Commonly known as rendezvous from above, this re-rendezvous is designed to simulate a lunar rendezvous which could take place if the lunar excursion module had descended to the 50,000-foot level above the Moon's surface and a decision not to continue for a landing was made. The LEM's highly elliptical orbit would carry it above the Command and Service Module before the two orbits could be matched. The Agena secondary propulsion system of two 200-pound thrust engines will make a series of maneuvers to place the Agena below and behind the Gemini spacecraft. Then the Gemini will perform a retrograde maneuver to match orbits with the Agena.

<u>SPS Separation maneuver</u> -- The second re-rendezvous begins at 47 hours 55 minutes (47:55) GET in the 30th revolution over Hawaii with a SPS posigrade burn of 30.7 fps. to put the Agena in a 186-by-205-mile orbit. The higher orbit causes the Agena to orbit more slowly and fall behind the Gemini.

<u>SPS Closing maneuver</u> -- At 50 hours 8 minutes (50:08) GET in the 32nd revolution over Ascension, a retrograde burn of 26.6 fps is made with the Secondary Propulsion System (SPS). The new orbit for the Agena is 169 by 204 miles. The Agena's perigee is now 17 miles below the Gemini and trails the spacecraft by 137 miles.

<u>SPS Co-elliptical Maneuver</u> -- Over Hawaii on the 32nd revolution, the final maneuver by the Agena will be made at 50 hours 55 minutes (50:55) GET, a retrograde burn of 57.2 fps which will change the Agena's orbit to 164 by 171 miles, 17 miles below the Gemini and trailing by 147 miles. The Gemini crew should have radar lock-on with the Agena at this time. At 50 hours 59 minutes (50:59) GET, the crew will switch the computer into the rendezvous mode.

Gemini terminal phase initiation -- At 51 hours and 56 minutes (51:56) GET or 12 minutes after sunset, on the 33rd revolution over Africa, the Gemini will perform a retrograde burn of 32.2 fps. The spacecraft will be pitched down 27 degrees. Range from the Agena at the time of the burn will be 38 miles.

Gemini Intermediate Corrections -- Two small burns will be made similar to the intermediate corrections applied for the first rendezvous with Agena. The first burn is made at 52 hours 9 minutes (52:09) GET and the range at the time of burn is 18 miles. The second burn comes 12 minutes later at 52 hours 21 minutes (52:21) GET and the range at time of burn is 4.5 miles.

Gemini Velocity Matching Maneuver -- A final burn of 42 fps will be made at 52 hours 30 minutes (52:30) GET to accomplish the braking into Agena's orbit over the Coastal Sentry Quebec tracking ship in the eastern Pacific. Docking will be done at approximately 52 hours, 40 minutes (52:40) GET over Hawaii.

SECONDARY PROPULSION SYSTEM DOCKED MANEUVER

At 53 hours 30 minutes in the 34th revolution over Tananarive, a final secondary propulsion system burn of 53 fps retrograde will be made. It will change the orbit of the two vehicles to 128 by 172 miles. The maneuver serves two purposes. It exercises the secondary propulsion system in the docked configuration for the first time and it reduces dispersions during the retrofire and reentry sequence.

FINAL SEPARATION

The Gemini spacecraft will perform a 3 fps retrograde maneuver at 53 hours 33 minutes (53:33) GET as the final separation maneuver from the Agena. The new orbit of the Gemini will be 123 by 171 miles.

RETROFIRE

Retrofire will occur at 70:12 GET during the spacecraft's 44th revolution. Splashdown will occur in the west Atlantic recovery area (26N75W) at 70:40 GET.

AGENA MANEUVERS FOLLOWING SPLASHDOWN

Four firings of the Agena have been scheduled immediately following Gemini reentry. They are minimum impulse burns to evaluate the Agena to make low propellant temperature starts.

On the following day, the Mission Control Center Real Time Computer Complex will be used to generate a simulated mission for the Agena in which a late (third day) Gemini spacecraft lift-off will be assumed. Given an incremental velocity budget of 1800 fps onboard the Agena, the computers will generate a real time flight plan for the Agena which will allow for a out-of-plane and a dwell maneuver by the rocket engine to put it into Gemini's simulated orbit. Gemini lift-off time and orbital maneuvers will also be calculated by the computers to produce a real time mission planning exercise. Generally, the simulated spacecraft launch is planned to start at the beginning of Agena revolution 61.

Following the "phantom" rendezvous exercise, the Agena will be commanded in out-of-plane maneuvers at a 253-mile circular orbit for fuel depletion. It will check the accuracy of the fuel measuring from the ground.

The Agena will be left as a passive target for possible future rendezvous by Gemini spacecraft. See Table II in this section for details of Agena burns.

ORBITS - REVOLUTIONS

The spacecraft's course is measured in revolutions around the Earth. A revolution is completed each time the spacecraft passes over 80 degrees west longitude, or at Gemini altitude about once every 96 minutes.

Orbits are space referenced and in Gemini take about 90 minutes.

The longer time for revolutions is caused by the Earth's rotation. As the spacecraft circles the Earth, the Earth moves about 22.5 degrees in the same direction, Although the spacecraft completes an orbit in about 90 minutes, it takes another six minutes for the spacecraft to reach 80 degrees west longitude and complete a revolution.

Gemini completes 16 orbits per day, but in 24 hours crosses the 80th meridian of longitude 15 times -- hence 15 revolutions per day.

GEMINI 9 MANEUVERS

Maneuver	Spacecraft Revolution Number	Approximate Spacecraft GET Begin: hr:min	Total V, fps	Thruster	Resultant perigee/apogee altitude above spherical earth
SECO + 20 Separation (S/C)	1	00:06	20.0	AFT	100/168
Phase adjustment (NC1) N=1.0 (S/C)	1	00:50	53.4	AFT	134/168
Corrective combination maneuver (N_{CC}) (S/C)	2	01:57	.8	AFT	136/168
Co-elliptical maneuver (N_{SR}) N=2.0 (S/C)	2	02:20	52.9	AFT	168/168
Terminal Phase initiation (TPI) (S/C)	3	03:27	32.4	AFT	169/187
81.8° Correction (S/C)	3	03:39	3.0		169/187
33.6 Correction (S/C)	3	03:51	5.0		169/187
Velocity Match (TPF) (S/C)	3	03:59	41.6	FWD	185/185

GEMINI 9 MANEUVERS (CONT'D)

Maneuver	Spacecraft Revolution Number	Approximate Spacecraft GET Begin: hr:min	Total V, fps	Thruster	Resultant perigee/apogee altitude above spherical earth
PPS translation #1 (out-of-plane) (Agena)	17	27:00	104.0	PPS	185/186
PPS translation #2 (in plane, posigrade) (Agena)	26	40:29	104.0	PPS	187/254
PPS translation #3 (in plane, retrograde) (Agena)	28	43:30	104.0	PPS	182/190
Spacecraft radial separation (S/C)	29	45:34	20.0	AFT	179/192
Semi-optical terminal phase initiation (TPI) (S/C)	30	46:47	1.9	AFT	179/192
Velocity match (TPF) (S/C)	30	47:07	15.7	FWD	182/191
Agena SPS separation maneuver (Agena)	30	47:55	30.7	SPS	186/205

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GEMINI 9 MANEUVERS (CONT'D)

Maneuver	Spacecraft Revolution Number	Approximate Spacecraft GET Begin: hr:min	Total V, fps	Thruster	Resultant perigee/apogee altitude above spherical earth
Agena SPS closing maneuver (Agena)	32	50:08	26.6	SPS	169/204
Agena SPS co-elliptical maneuver (Agena)	32	50:55	57.2	SPS	164/171
Re-rendezvous terminal phase initiation (S/C)	33	51:57	32.2	AFT	168/187
Re-rendezvous 81.8° correction (S/C)	33	52:09	2.0		168/187
Re-rendezvous 33.6° correction (S/C)	33	52:21	1.0		168/187
Re-rendezvous velocity match (S/C)	33	52:30	43.2	FWD	164/172
Final Agena SPS maneuver (Agena)	34	53:30	53.0	SPS	128/171
S/C-Agena separation (S/C)	34	53:33	3.0	FWD	126/171

GEMINI 9 MANEUVERS (CONT'D)

Maneuver	Spacecraft Revolution Number	Approximate Spacecraft GET Begin: hr:min	Total V, fps	Thruster	Resultant perigee/apogee altitude above spherical earth
Retrofire (S/C)	44	70:12	318.5	RETROS	

AGENA MANEUVERS CHART

Burn	Target GET	Agena REV	Site	Duration	Attitude	Orbit After Burn
Gemini Program Office 1 (Stored Program Command)	73:39	46/47	TEX	1 sec	-90°	132/169
Gemini Program Office 2 (Real Time Command)	74:34	47	CRO	9 sec	0-0-0	198/169
Gemini Program Office 3 (Real Time Command)	74:59	47	HAW	1 sec	0-0-0	
Gemini Program Office 4 (Stored Program Command)	76:34	48	HAW	1 sec	0-180-0	198/169

EXPERIMENTS

Seven experiments are scheduled to be flown on Gemini 9. Four will be performed during the pilot's extravehicular activity. Four have been flown on previous flights. The experiments are divided into three categories: scientific, four experiments; technological, two experiments; and medical, one experiment.

SCIENTIFIC

S-1 Zodiacal Light Photography

Purpose - To obtain photographs of zodiacal light, air-glow layer, and dim light phenomena. Flown on Gemini 5 and 8.

Equipment - Widelux camera, Model F VI. Field of view 50 degrees by 130 degrees. Lens opening is f/1. Focal length 20 mm. Weight 3.5 pounds. Film - Eastman Tri-X 35 mm, ASA 400, b & w, 18 exposures.

Procedure - Camera will be hand-held by the EVA pilot standing in the spacecraft seat just prior to ingress. He will operate the camera for approximately 5-10 minutes to photograph the Milky Way and the night air glow layer unattenuated by the spacecraft window. It will operate automatically after arming by the pilot, making several 30 second exposures 10 seconds apart.

Experimenter - Dr. E. P. Ney and W. F. Huch, University of Minnesota, Misseapolis.

S-10 Micrometeorite Cratering

Purpose - To obtain samples of micrometeoroid impacts on different types of materials and return them uncontaminated to Earth for laboratory analysis. Flown on Gemini 8, but not fully activated.

Equipment - Micrometeorite impact package is mounted on the target docking adapter of the Agena before liftoff. The rectangular package is hinged to fold open and expose eight plates of highly polished surfaces such as metal, plastic, glass, etc.

Procedure - The package will be launched onboard the Agena in the closed position. The pilot, after leaving the spacecraft on EVA, will move to the Agena and open the package. It will be retrieved by another EVA pilot on a later rendezvous flight and analyzed for meteoroid impact and cratering.

Experimenter - Dr. Curtis Hemenway and Royce Coon, Dudley Observatory, Albany, N.Y.

S-11 Airglow Horizon Photography

Purpose - To take photographs of the Earth airglow layer in the atomic oxygen and sodium light spectra in order to study the character and dynamics of the upper atmosphere where airglow occurs.

Equipment - Maurer camera, 70 mm, loaded with Eastman Kodak 103-D spectrographic film, The exposures will be made on black and white film at f/0.95, with a shutter speed of 5, 10 and 40 seconds. Lens is 50 mm with a double peak objective interference filter to separate the two light wave lengths. An extended exposure timer, an illuminated camera sight, and a two-point variable pitch bracket for mounting the camera in the pilot's window are also carried.

Procedure - A series of 12 exposures, three at each position 90° apart, will be taken during a night pass, with the spacecraft pointed directly toward the airglow layer. The time of the start of the exposure will be recorded and the cabin will be darkened to prevent cabin light reflection. The crew will also attempt to take two photographs of the twilight horizon at approximately three minutes before sunrise to obtain photographs of day airglow.

Experimenters - Martin J. Koomen and Donald M. Packer, U.S. Naval Research Laboratory, Washington, D.C.

S-12 Micrometeorite Collection

Purpose - (1) To collect ultra-small meteoroids in near-Earth space to study the nature and frequency of hyperballistic impacts under in-flight conditions, and (2) to expose microbiological specimens to the space environment to determine their ability to survive the vacuum, extreme temperatures, and radiation in space, and (3) to search for any organisms capable of living on micrometeoroids in space.

Equipment - Aluminum collection box, 11 inches long by 5.5 inches wide by 1.25 inches deep, weighing 7 pounds 6 ounces. The device has two collection compartments and an internal electric motor and thermally insulated batteries. The collection compartment materials are aluminum-shadowed 200-Angstrom-thick nitrocellulose and formvar mounted on 200-mesh copper screening. They are the same collection materials used by the experimenters in previous rocket, balloon and aircraft sampling experiments.

-more-

Procedure - The experiment will be mounted in the retro adapter directly behind the pilot's hatch. The hinged lid can be opened or closed electrically from inside the spacecraft. It is planned to open the experiment only during the first eight-hour sleep period of the crew when the spacecraft is in drifting flight in order to avoid contamination by the OAMS system. One of the compartments will be sterilized to determine the presence or absence of microorganisms in the micrometeorites collected. When returned to the laboratory, cultures designed for non-terrestrial organisms will be prepared to determine if any types of life are present in the sample. A set of representative Earth microorganisms such as bacteria, molds, and spores will be placed in the non-sterile compartment. They will be quantatively assayed after the flight exposure to determine the fractions which survive. During the first portion of EVA, the pilot will lock the collection box and return it to the spacecraft cabin.

Experimenters - Dr. Curtis Hemenway and Royce Coon, Dudley Observatory, Albany, N.Y.

TECHNOLOGICAL

D-12 Astronaut Maneuvering Unit

Purpose - To provide extravehicular mobility and control for man outside the spacecraft in attitude and translation, and to provide oxygen supply and communications.

Equipment - The Astronaut Maneuvering Unit; a rectangular backpack of aluminum weighing 166 pounds fully loaded. Its dimensions are 32-inches-high-by-22-inches-wide-by-19-inches-deep with a form-fitting cradle on the inside where the astronaut is seated during flight. The unit has 12 small thrusters mounted on the corners of the pack. There are four forward-firing thrusters, four aft-firing, two up and two down. The fuel is 24 pounds of hydrogen peroxide stored in the backpack. Firing of the thrusters is controlled by two sidearm supports attached to the backpack structure. The left-hand assembly gives the crew member translation control in four directions, a switch for selecting manual or automatic stabilization and volume control of the communications. The right-hand arm contains controls for positioning the crew member in pitch, roll and yaw.

An oxygen supply of seven and one-half pounds is also carried in the backpack. A battery powered UHF transceiver mounted on the top of the backpack provides communications between the EVA astronaut and the spacecraft.

Green running lights on the pack, one above either shoulder, one on the bottom, and one on the top behind the UHF wedge-shaped antenna will allow the crew member in the spacecraft to follow the movements of the EVA crewman at all times. The backpack has a total Delta V of 250-275 fps or 3000-3500 pound seconds of impulse. Each thruster produces about 2.3 pounds of thrust.

Procedure - The AMU will be mounted in the rear of the adapter section at liftoff. During the first night pass while the pilot is outside the spacecraft, he will go to the adapter and put on the backpack, connecting it to the chestpack which provides circulation and cooling for the space suit, using backpack oxygen. At the second daylight pass he will move in front of the spacecraft to the 25-foot connect point on the 125-foot tether and perform a series of attitude control checks and translation maneuvers of less than one half fps. After the command pilot has translated the spacecraft to him, the EVA crewman will translate to the Agena and perform several maneuvers before returning to the spacecraft where he will reconnect to the spacecraft oxygen supply, take off and jettison the backpack.

Project Officer - Major Edward G. Givens, Detachment 2, Space Systems Division of Air Force Systems Command, Houston, Texas.

D-14 UHF/VHF Polarization

Purpose - To obtain information on communication systems operating through the ionosphere.

Equipment - A UHF/VHF transmitter with eight-foot extendable antenna mounted on the top centerline of the spacecraft on the retro adapter section.

Procedure - When the spacecraft is over tracking stations at Hawaii and Antigua, the system will be turned on to broadcast a signal at two wavelengths. A 30-foot antenna dish on the ground would pick up the signal and be recorded on audio tape on a chart recorder and signal visual characteristics will be recorded by motion picture from an oscilloscope. The experiment is designed to provide information on regular and irregular fading of radar and radio signals coming through the ionosphere.

Experimenter - Robert Ellis, Naval Research Laboratory, Washington, D.C.

MEDICAL

M-5 Bioassay of Body Fluids

Purpose - To collect body fluids before, during and immediately after flight for analysis of hormones, electrolytes, proteins, amino acids and enzymes which might result from space flight.

Method - Urine will be collected in a special bag for each elimination. A specified amount of tritiated water will be added automatically. The water has a tracer amount of radioactive tritium. By comparing the amount of tritium in the sample with the known amount of tritium placed in it, biochemists can measure the total volume. Twenty-four 75-cc-capacity sample bags will be carried. A sample will be drawn for each elimination. The remaining urine will be transferred into the urine dump system of the spacecraft.

CREW PROVISIONS AND TRAINING

CREW TRAINING BACKGROUND

In addition to the extensive general training received prior to flight assignment, the following preparations have or will be accomplished prior to launch:

1. Launch abort training in the Gemini Mission Simulator and the Dynamic Crew Procedures Simulator.

2. Egress and recovery activities using a crew procedures development trainer, spacecraft boilerplate model and actual recovery equipment and personnel. Pad emergency egress training using elevator and slide wire, and breathing apparatus.

3. Celestial pattern recognition in the University of North Carolina's Morehead Planetarium at Chapel Hill.

4. Zero gravity training in KC-135 aircraft to practice EVA. Stowage and donning of EVA equipment is done in aircraft and crew procedures trainer. AMU firing was done in the 35-foot vacuum chamber at MSC. Additional EVA training is performed in 20-foot chamber at vacuum conditions.

5. Suit, seat and harness fittings.

6. Training sessions totaling approximately 15 hours per crew member on the Gemini translation and docking simulator.

7. Detailed Agena and Gemini systems briefing; detailed experiment briefings; flight plans and mission rules reviews.

8. Participation in mock-up reviews, systems review, subsystem tests, and spacecraft acceptance review.

9. Ejection seat training.

During final preparation for flight, the crew participates in network launch abort simulations, joint combined systems test, and the final simulated flight tests. At T-2 days, the major flight crew medical examinations will be administered to confirm readiness for flight and obtain data for comparison with post flight medical examination results.

GEMINI 9 SUITS

The pressure suit worn by the command pilot will be similar to suits worn on Gemini 4,5,6 and 8. The pilot will wear a suit with special thermal protective cover layers for EVA activities.

COMMAND PILOT SUIT

The Gemini command pilot's suit has five layers and weighs 23 pounds. The layers are, starting inside the suit:

1. White cotton constant wear undergarment with pockets around the waist to hold biomedical instrumentation equipment

2. Blue nylon comfort layer

3. Black neoprene-coated nylon pressure garment

4. Restraint layer of nylon link net to restrain pressure garment and maintain its shape.

5. White HT-1 nylon outer layer

PILOT SUIT

The first four layers of the pilot's suit are the same as the first four layers of the command pilot's suit. However, the pilot wears two types of cover layers, one for the arms and torso, the second for the leg section beginning at the groin line.

Upper torso cover lay-up is:

1. Seven layers of high-temperature superinsulation

2. Two layers of nylon micrometeoroid protection

3. One layer of high-temperature nylon

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EXTRAVEHICULAR SUIT

G-IV EVA COVERLAYER CONFIGURATION

HT-1 NYLON OUTER PROTECTIVE LAYER

HT-1 NYLON MICROMETEOROID ABSORBER

SUPER INSULATION

HT-1 NYLON INNER MICROMETEOROID STOPPER LAYERS

G-IX EVA COVERLAYER CONFIGURATION

HT-1 NYLON OUTER PROTECTIVE LAYER

SUPER INSULATION

COATED NYLON INNER MICROMETEOROID PROTECTIVE LAYERS

CHROMEL R CLOTH

HIGH TEMP SUPER INSULATION

NYLON MICRO-METEOROID PROTECTIVE LAYERS

Leg cover lay-up is:

1. Three layers of nylon micrometeoroid protection

2. Four layers of high-temperature superinsulation

3. One layer of Chromal R, woven metal cloth

Weight of the extravehicular suit for Gemini 9 is 35 pounds. The special EVA cover layer for the legs was tested in unmanned backpack firings at the General Electric Valley Forge vacuum facility and in three manned runs at the 35-foot vacuum chamber at MSC. The leg cover layer is qualified to withstand surface temperatures of 1200 degrees Fahrenheit while keeping the suit internal temperature no more than 110 degrees Fahrenheit. The EVA suit also was subjected to the usual suit materials qualification program. Eight EVA suits with the special leg cover layer were built, three for qualification and five suits for training and flight wear for the primary and back-up pilots.

For extravehicular activity, the pilot will carry a detachable overvisor which has attach points on both sides of the helmet and can be swiveled into place over the faceplate. The outervisor is gold-coated and provides protection for the eyes from solar glare. The faceplate is a polycarbonate material which provides impact and micrometeoroid protection.

Before EVA, the pilot will don a special pair of suit gloves with built-in insulation. Additional heat protection for the hands will be provided while the pilot is using the Astronaut Maneuvering Unit.

When the cabin is depressurized, the suit automatically pressurizes to 3.7 psi and provides breathing oxygen for both crew members.

EXTRAVEHICULAR LIFE SUPPORT SYSTEM (ELSS)

It is a 42-pound rectangular box which is worn on the chest. It provides electrical, mechanical and life support connections between the EVA astronaut and the spacecraft. System is 18 inches high, 10 inches wide and six inches deep. It contains ejector pump for circulation, a heat exchanger for cooling air, a 30-minute emergency oxygen supply. Controls and a warning system for the emergency oxygen supply are mounted on the top of the unit. Used in combination with the AMU, the ELSS functions as a suit pressurization and air supply system during EVA.

UMBILICAL TETHER

There are two tether lines which the astronaut will use outside the spacecraft. The 25-foot umbilical is carried inside the cabin and attached to the ELSS and the parachute harness. It contains an oxygen supply line, 1000-pound test nylon tether, and electrical hardline for communications and bioinstrumentation. The oxygen line is protected from temperature extremes by layers of aluminized Mylar wrapped around it. The whole unit is encased in a white nylon sleeve. The umbilical is attached to the nose of the spacecraft during portions of EVA. A nylon strap with hook is used to attach the umbilical to eye in spacecraft nose. The strap is secured around the umbilical. This attach point prevents the umbilical near the spacecraft from looping or drifting near thrusters or other external equipment.

The 125-foot umbilical is composed of nylon cord, 1000-pound-test. The last 15-foot-length is wrapped with super-insulation aluminized H-Film with fiberglass spacers to protect the tether from thruster exhaust of the AMU. Metal snap hook attachment points are located at 25 feet and the end of the tether. The long tether is stored in a nylon bag fixed in place on top of the AMU by the EVA crewman. The bag allows the tether to pay out on both sides. One side is attached to the parachute harness ring, the other to the 25-foot tether. When the tether is completely out, the bag can be jettisoned.

70MM HASSELBLAD CAMERA

I. Camera

A. Equipment

1. Camera (Inboard)
   80 mm lens
   f2.8 to f22.0 aperture
   Time exposures and speeds up to 1/500 seconds
   Resolution: approximately 125 lines/mm
   Approximately 1.5X magnification
   General Purpose - EVA

2. EVA Camera
   70MM superwide angle Hasselblad
   90° field of view
   38 mm lens
   All other details same as inboard camera

3. 70 MM Mauer
   f2.8
   50mm and 80mm Lens
   Purpose: For S-11 experiment and general development and evaluation of the cameras.

16MM MAURER MOVIE CAMERA

I. Camera

1. Outboard Camera
   5 mm lens
   160° field of view
   5.4 inches focal length

2. Inboard Camera
   18 mm and 75 lenses
   All other characteristics are the same as outboard camera except for field of view

II. Film

A. Fifteen magazines each approximately 80 feet of film

B. Kodak S.O. 217 color film

III. Purpose

Agena and rendezvous photographs
Extravehicular activity
General Purposes

WATER MEASURING SYSTEM

A mechanical measuring system has been added to water gun. It consists of a neoprene bellows housed in a small metal cylinder mounted at base of gun. The bellows holds one-half ounce of water. When plunger of gun is depressed, a spring pushes water out of bellows and through gun. A counter in right side of gun registers number of times bellows is activated. Each crewman will record how much he drinks by noting numbers at beginning and end of each use of gun.

FOOD

Number of Meals -- Ten per astronaut for mission.

Type -- Bite-sized and rehydratable. Water is placed in rehydratables with special gun. Bite-sized items need no rehydration.

Storage -- Meals individually wrapped in aluminum foil and polyethelene, polyamide laminate. All meals are stored in the right aft food box over the pilot's right shoulder.

GEMINI 9 FLIGHT MENU
(THREE DAY MENU CYCLE)

DAY 1:

Meal B		Calories
(B)	Fruit Cake (Pineapple)	253
(B)	Cheese Sandwiches (6)	324
(B)	Peanut Cubes (6)	297
(B)	Cinnamon Toast (6)	99
(R)	Grapefruit Drink	83
(R)	Orange-Grapefruit Drink	83
		1139

Meal C		
(R)	Chicken & Gravy	92
(R)	Apricot Pudding	300
(B)	Toasted Bread Cubes (6)	161
(B)	Brownies (6)	241
(R)	Orange Drink	83
(R)	Grapefruit Drink	83
		960

DAY 1 TOTAL 2099

DAY 2:

Meal A		Calories
(R)	Beef & Gravy	160
(B)	Strawberry Cereal Cubes	169
(B)	Beef Sandwiches (6)	298
(R)	Peaches	98
(R)	Grapefruit Drink	83
(R)	Orange Drink	83
		891

Meal B		
(R)	Beef Pot Roast	119
(R)	Potato Salad	143
(B)	Cinnamon Toast (6)	99
(R)	Chocolate Pudding	307
(B)	Brownies (6)	241
(R)	Orange-Grapefruit Drink	83
		992

-more-

DAY 2 (Con'd)

Meal C		Calories
(R)	Spaghetti & Meat	70
(R)	Applesauce	165
(B)	Cheese Sandwiches (6)	324
(B)	Fruitcake (Date) (4)	262
(R)	Orange Drink	83
(R)	Grapefruit Drink	83
		987

DAY 2 TOTAL 2870

DAY 3

Meal A		Calories
(B)	Fruitcake (Pineapple)	253
(B)	Cheese Sandwiches (6)	324
(B)	Peanut Cubes (6)	297
(B)	Cinnamon Toast (6)	99
(R)	Grapefruit Drink	83
(R)	Orange-Grapefruit Drink	83
		1139

Meal B		
(B)	Bacon Squares (8)	180
(B)	Apricot Cereal Cubes (6)	171
(B)	Cinnamon Toast (6)	99
(R)	Applesauce	165
(R)	Cocoa	190
		805

Meal C		
(R)	Shrimp Cocktail	119
(R)	Beef & Vegetables	98
(B)	Strawberry Cereal Cubes (6)	169
(B)	Fruitcake (Pineapple) (4)	253
(R)	Grapefruit Drink	83
(R)	Orange-Grapefruit Drink	83
		805

DAY 3 TOTAL 2749

-more-

SUPPLEMENTARY FOOD

Meal A		Calories
(R)	Chicken Salad	237
(B)	Toasted Bread Cubes (6)	161
(B)	Gingerbread (6)	183
(R)	Banana Pudding	282
(R)	Orange Drink	83
(R)	Grapefruit Drink	83
		1029

Meal B		Calories
(B)	Fruit Cake (Pineapple)	253
(B)	Cheese Sandwiches (6)	324
(B)	Peanut Cubes (6)	297
(B)	Cinnamon Toast (6)	99
(R)	Grapefruit Drink	83
(R)	Orange-Grapefruit Drink	83
		1139

MEDICAL CHECKS

At least one medical check a day will be made by each crew member. Performed over a convenient ground station, a check will consist of: oral temperature and food and water intake evaluation.

BODY WASTE DISPOSAL

Solid Wastes -- Plastic bag with adhesive lip to provide secure attachment to body. Contains germicide which prevents formation of bacteria and gas. Adhesive lip also used to form seal for bag after use and bag is stowed in empty food container box and brought back for analysis.

Urine -- Voided into fitted receptacle connected by hose to either a collection device or overboard dump.

MANNED SPACE FLIGHT TRACKING NETWORK GEMINI 9 MISSION REQUIREMENTS

NASA operates the Manned Space Flight Tracking Network by using its own facilities and those of the Department of Defense for mission information and control.

For Gemini 9 the network will provide flight controllers:

(1) Radar tracking, command control, voice and telemetry data are available from launch through Gemini spacecraft splashdown in recovery area. Except for voice communications the network provides the same functions for the Agena as long as electrical power is available.

(2) Verification of the proper operation of the systems onboard the Gemini and Agena target.

The network also will update via the control center, the spacecraft computer to provide ephemeris (computed space position) and reentry displays for the astronauts.

Immediate computing support will be provided from launch through impact by the Real-Time Computer Complex (RTCC) at the Manned Spacecraft Center. During powered flight, the RTCC will receive launch trajectory data from Bermuda and Air Force Eastern Test Range (AFETR) radars via the Cape Kennedy CDC-3600 computing complex.

TRACKING

The Gemini mission will require separate tracking of four space vehicles: the Gemini spacecraft, the Agena Target Vehicle (ATV), Titan II which is the Gemini Launch Vehicle (GLV), and as required, the Atlas Booster called SLV-3. The Gemini Target Vehicle will carry one C-band and one S-band beacon. Skin tracking (radar signal bounce) of the spacecraft, Agena target vehicle, and Gemini launch vehicle throughout orbital lifetime is a mission requirement. The MSFN Wallops Station (WLP) Space Range Radar (SPANDAR) and various facilities of the North American Air Defense Command (NORAD) will be used for this mission. However, NORAD will not track during the rendezvous phase.

For Gemini 9, various combinations of spacecraft tracking assignments will be carried out according to individual station capability. Some sites have radar systems capable of providing space position information on both the Gemini and Agena vehicles simultaneously through their Verlort (S-band) and FPS-16 (C-band) antennas. Data transmission links, however, have only a single system capability; therefore, priority will be established by the Mission Director or Flight Dynamics Officer according to their needs.

After Titan II launch, the spacecraft will be the prime target for C-band tracking.

Manned Space Flight Tracking Network Configuration

Cape Kennedy, Fla
Merritt Island,
Patrick AFB, Fla.
Grand Bahama Island
Ascension Island
Antigua Island
Bermuda Island, BWI

Pretoria, South Africa
Kano, Nigeria
Carnarvon, Australia

Grand Canary Island
Pt. Arguello, Calif.
White Sands, N.M.
Kauai, Hawaii
USNS Rose Knot
USNS Coastal Sentry
USNS Range Tracker
Canton Island
Grand Turk Island
Tananarive, Malagasy
Eglin, Fla.
Corpus Christi, Texas

Stations Capable of C-Band Tracking are:

Merritt Island, Fla.
Patrick AFB, Fla.
Grand Bahama Island
Antigua Island
Ascension Island
Carnarvon, Australia
Bermuda Island, BWI
Pretoria, South Africa

White Sands, N.M.
USNS Range Tracker
Eglin, Fla.
Grand Turk Island
Grand Canary Island
Pt. Arguello, Calif.
Kauai, Hawaii

Stations Capable of S-Band Tracking are:

	Carnarvon, Australia
Bermuda Island, BWI	Kauai, Hawaii
Grand Canary Island	Guaymas, Mexico
Pt. Arguello, Calif.	Corpus Christi, Texas

Stations Capable of Skin (radar signal bounce) Tracking the Gemini Launch Vehicle, Spacecraft, and the Agena Target Vehicle are:

Merritt Island, Fla.	Carnarvon, Australia
Patrick AFB, Fla.	White Sands, N.M.
Grand Bahama Island	
Antigua Island	Eglin, Fla.
Ascension Island	Grand Turk Island

Skin tracking procedures will be used as needed as mission priorities permit.

Other Computer Support

NASA's Goddard Space Flight Center, Greenbelt, Md., realtime computing support for Gemini 9 includes the processing of realtime tracking information obtained from the Titan II and Agena systems beginning with mission simulations through Gemini spacecraft recovery and Agena lifetime.

Goddard's computer also will certify the worldwide netowrk's readiness to support Gemini 9 through a system-by-system, station-by-station, computer-programmed check-out method called CADFISS tests. CADFISS (Computation and Data Flow Integrated Subsystem) checkout of network facilities also will be performed by Goddard during post-launch periods when the spacecraft are not electronically "visible" by some stations and continue until the vehicles are again within acquistion range.

Control of the entire Gemini 9 mission will be exercised by the Mission Control Center in Houston. As it did on the Gemini 8 mission, Houston will serve as the computer center.

Gemini Spacecraft

The spacecraft has two C-Band tracking beacons. The model ACF beacon (spacecraft) will be installed in the reentry module and the DPN-66 model beacon (adapter) in the adapter package.

The ACF beacon will be prime for launch, insertion, and reentry phase, using the DPN-66 as a backup for these periods.

AGENA TARGET VEHICLE

The Agena target vehicle will contain one C-band and one S-band beacon. The C-band beacon will be a modified DPN-66. The C-band beacon will be prime for Agena Target Vehicle prior to the Gemini launch. The Gemini spacecraft will be the prime target for C-band tracking following launch.

ACQUISITION SYSTEMS

Sites with spacecraft aid systems capable of tracking the Agena and Gemini spacecraft simultaneously will provide radio frequency (RF) inputs and pointing data to their associated telemetry receivers and steerable antennas. Sites which do not have simultaneous-tracking capability will track the Gemini spacecraft only. All stations will track the Gemini spacecraft only. All stations will track the Agena target vehicle until orbital insertion of the Gemini spacecraft.

MISSION MESSAGE REQUIREMENTS

Low speed telemetry data (on-site teletype summaries) from flight controller manned stations will be sent to the Houston Mission Control Center.

Bermuda and Corpus Christi transmit Gemini spacecraft or Agena target vehicle PCM telemetry via high-speed digital data to Houston Mission Control Center in computer format. MCC-K/TEL III, Grand Bahama Island, Grand Turk Island, and Antigua will remote Gemini spacecraft and Agena wide-band data to the Houston Mission Control Center in the same manner.

SPACECRAFT COMMAND SYSTEM

The prime ground system in effecting rendezvous is the Digital Command System (DCS) located at key stations throughout the worldwide network. Command control of the mission from launch through recovery will as always be provided by the Flight Director at Houston Mission Control Center. Maximum command coverage is required throughout the mission.

Grand Canary Island; Carnarvon, Australia; Hawaii; and the two ships, USNS Coastal Sentry and USNS Rose Knot; are DCS equipped and manned by flight controllers who will initiate all uplink data command transmissions.

Following astronaut recovery, further commands will be required for the Agena target vehicle. Network Digital Command System support will be continued throughout the Agena target vehicle battery lifetime.

The Texas, Cape Kennedy, Grand Bahama, Grand Turk, Antigua, and Bermuda sites will not be manned by flight controllers. All uplink data command transmissions through these sites will be remoted in real time from Houston Control Center.

In addition to realtime commands and onboard clock update commands, the following digital instructions may be sent:

a. Gemini spacecraft

1. Preretro with maneuver
2. Preretro without maneuver
3. Orbital navigation
4. Maneuver
5. Rendezvous
6. Accelerometer error corrections

b. Agena Target Vehicle

1. Maneuver
2. Ephemeris
3. Engine burn time

SPACECRAFT COMMUNICATIONS

All MSFN stations having both HF and UHF spacecraft communications can be controlled either by the station or by remote (tone) keying from Houston Mission Control Center and from Goddard.

The following sites are not scheduled to have a command communicator (Cap Com) and will be remoted to Houston Mission Control Center:

> Cape Kennedy, Grand Bahama Island; Tananarive, Malagasy Republic; Kano, Nigeria; Bermuda; Grand Turk Island; Pt. Arguello, Calif.; Antigua Island; Ascension Island; Canton Island; USNS Range Tracker, and the voice relay aircraft.

SPACECRAFT SYSTEMS SUPPORT

The Gemini spacecraft communications system (antennas, beacons, voice communications, telemetry transmitters, recovery light, and digital command system) allows radar tracking of the spacecraft, two-way voice communications between the ground and the spacecraft and from astronaut to astronaut; ground command of the spacecraft; instrumentation systems data transmission, and postlanding and recovery data transmission. The sole link between the ground and the Gemini spacecraft is provided by these systems.

The Agena target vehicle communications systems (antennas, beacons, telemetry transmitters, and digital command system) allows radar tracking of the vehicle from both the ground and the Gemini spacecraft. Ground station and Gemini spacecraft command to the Agena also are accomplished through this system.

Agena Target Vehicle On-Board Systems supported by Network Stations.

Table #1

Telemetry (Real Time)
Telemetry (Dump)
L-Band Transponder
S-Band Transponder
C-Band Transponder
Command Receiver (Range Safety)
Command Receiver (Command Control)

Gemini Spacecraft On-Board Systems Support by Network Stations

Table #2

Reentry Module	UHF (voice)xmit-Rcv
Reentry Module	HF (voice)xmit-Rcv
Reentry Module	Telemetry (Real Time)
Reentry Module	Telemetry (Dump)
Reentry Module	Telemetry (Backup)
Adapter Package	L-Band Radar (Telemetry Readouts)
Reentry Module	C-Band Transponder
Adapter Package	C-Band Transponder
Adapter Package	Acquisition Aid Beacon
Adapter Package	Digital Command System
Reentry Module	UHF Recovery Beacon

GROUND COMMUNICATIONS

The NASA Communications Network (NASCOM) used for Gemini 8 will be used for Gemini 9. Shore stations for USNS Rose Knot and USNS Coastal Sentry Ship support will be based upon the mission-designated ship positions and predicted HF radio propagation conditions.

NETWORK CONFIGURATION

Systems / Stations	WLP	A/C	RTK	RKV	CSQ	ASC	ANT	EGL	WHS	TEX	CAL	GYM	HAW	CTN	CRO	PRE	TAN	KNO	CYI	BDA	GTK	GBI	PAT	CNV	MLA	MCC-K	MCC-H
C-Band Radar			X			X	X	X	X		X		X		X	X			X	X	X	X	X	X	X		
S-Band Radar										X	X	X	X		X				X	X				X			
Telemetry Receive & Record		X	X	X	X	X	X			X	X	X	X	X	X		X	X	X	X	X	X		X		X	
Telemetry Real Time Display				X	X							X	X		X				X								X
Low Speed (TTY) Telemetry Data Transmission				X	X							X	X		X				X								
Wide Band Data							X														X	X				X	
High Speed Data							X			X										X	X	X				X	
On Site Data Process & Summary				X	X							X	X		X				X								X
Gemini Launch Vehicle Telemetry																								X		X	
Gemini Launch Vehicle Command							X														X	X		X		X	
Digital Command System				X	X		X			X			X		X				X	X	X			X		X	X
Voice - Transmit & Receive		X	X	X	X	X	X			X	X	X	X	X	X		X	X	X	X	X	X		X		X	X
Teletype - Transmit & Receive	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		X	X
Flight Control Team Manned				X	X							X	X		X				X								X
Spacecraft Acquisition Aid System	X		X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X				X	

NETWORK RESPONSIBILITY

Manned Spacecraft Center (MSC). The direction and mission control of the Network immediately preceding and during a mission simulation or an actual mission is responsibility of the MSC.

Goddard Space Flight Center. The NASA Office of Tracking and Data Acquisition has centralized the responsibility for the planning, implementation, and technical operations of manned space flight tracking and data acquisition at the Goddard Space Flight Center. Technical operation is defined as the operation, maintenance, modification, and augmentation of tracking and data acquisition facilities to function as an instrumentation network in response to mission requirements. About 370 persons directly support the network at Goddard; contractor personnel bring the total network level to some 1500.

Department of Supply, Australia. The Department of Supply, Commonwealth of Australia, is responsible for the maintenance and operation of the NASA station at Carnarvon, Australia. Contractual arrangements and agreements define this cooperative effort.

Department of Defense (DOD). The DOD is responsible for the maintenance and operational control of those DOD assets and facilities required to support Project Gemini. These include network stations at the Eastern Test Range, Western Test Range, White Sands Missile Range, the Air Proving Ground Center, and the tracking and telemetry ships.

ABORT AND RECOVERY

CREW SAFETY

Every Gemini system affecting crew safety has a redundant (backup) feature. The Malfunction Detection System aboard the launch vehicle monitors subsystem performance and warns the crew of a potentially catastrophic malfunction in time for escape.

There are three modes of escape:

MODE I	Ejection seats, and personal parachutes, used at ground level and during first 50 seconds of powered flight, or during descent after reentry.
MODE II	Retrorockets used, allowing crew to salvo fire all four solid retrorockets after engine shutdown is commanded.

MODE III — Normal separation from launch vehicle, using OAMS thrusters, then making normal reentry, using computer.

Except for Mode I, spacecraft separates from Gemini Launch Vehicle, turns blunt-end forward, then completes re-entry and landing with crew aboard.

Survival Package

Survival gear, mounted on each ejection seat and attached to the astronaut's parachute harnesses by nylon line, weighs 23 pounds.

Each astronaut has:

3.5 pounds of drinking water.

Machete.

One-man life raft, 5½ by 3 feet, with CO_2 bottle for inflation, sea anchor, dye markers, nylon sun bonnet.

Survival light (strobe), with flashlight, signal mirror, compass, sewing kit, 14 feet of nylon line, cotton balls and striker, halazone tablets, a whistle, and batteries for power.

Survival radio, with homing beacon and voice transmission and reception.

Sunglasses.

Desalter kit, with brickettes enough to desalt eight pints of seawater.

Medical kit, containing stimulant, pain, motion sickness and antibiotic tablets and aspirin, plus injectors for pain and motion sickness.

PLANNED AND CONTINGENCY LANDING AREAS

There are two types of landing areas for Gemini 9, planned and contingency. Planned areas are those where recovery forces are pre-positioned to recover spacecraft and crew within a short time. All other areas under the orbital track are contingency areas, requiring special search and rescue techniques and a longer recovery period.

Planned Landing Areas

PRIMARY	Landing in the West Atlantic (45-1) where the primary recovery vessel, an aircraft carrier, is pre-positioned.
SECONDARY	Landing in East Atlantic, West Pacific and Mid-Pacific areas where ships are deployed.
LAUNCH SITE	Landing in the event of off-the-pad abort or abort during early phase of flight, includes an area about 41 miles seaward from Cape Kennedy, 3 miles toward Banana River from Complex 19.
LAUNCH ABORT	Landing in the event of abort during powered flight, extending from 41 miles at sea from Cape Kennedy to west coast of Africa.

Contingency Landing Areas

All the areas beneath the spacecraft's ground track except those designated Planned Landing Areas are Contingency Landing Areas, requiring aircraft and pararescue support for recovery within a period of 18 hours from splashdown.

Recovery forces will be provided by the military services, and during mission time will be under the operational control of the Department of Defense Manager for Manned Space Flight Support Operations.

SPACECRAFT AND LAUNCH VEHICLES

GEMINI SPACECRAFT

The Gemini spacecraft is conical, 18 feet, 5 inches long, 10 feet in diameter at its base and 39 inches in diameter at the top. Its two major sections are the reentry module and the adapter section.

Reentry Module

The reentry module is 11 feet high and $7\frac{1}{2}$ feet in diameter at its base. It has three main sections: (1) rendezvous and recovery (R&R), (2) reentry control (RCS), and (3) cabin.

Rendezvous and recovery section is the forward (small) end of the spacecraft, containing drogue, pilot and main parachutes and radar.

Reentry control section is between R&R and cabin sections and contains fuel and oxidizer tanks, valves, tubing and two rings of eight attitude control thrusters each for control during reentry. A parachute adapter assembly is included for main parachute attachment.

Cabin section between RCS and adapter section, houses the crew seated side-by-side, their instruments and controls. Above each seat is a hatch. Crew compartment is pressurized titanium hull. Equipment not requiring pressurized environment is located between pressure hull and outer beryllium shell which is corrugated and shingled to provide aerodynamic and heat protection. Dish-shaped heat shield forms the large end of cabin section.

Adapter Section. The adapter is $7\frac{1}{2}$ feet high and 10 feet in diameter at its base, containing retrograde and equipment sections.

Retrograde section contains four solid retrograde rockets and part of the radiator for the cooling system.

Equipment section contains fuel cells for electrical power, fuel for the orbit attitude and maneuver system (OAMS), primary oxygen for the environmental control system (ECS), cryogenic oxygen and hydrogen for fuel cell system. It also serves as a radiator for the cooling system, also contained in the equipment section.

NOTE: The equipment section is jettisoned immediately before retrorockets are fired for reentry. The retrograde section is jettisoned after retros are fired.

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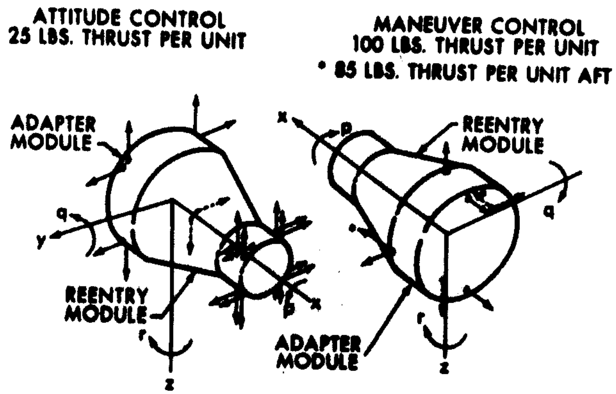
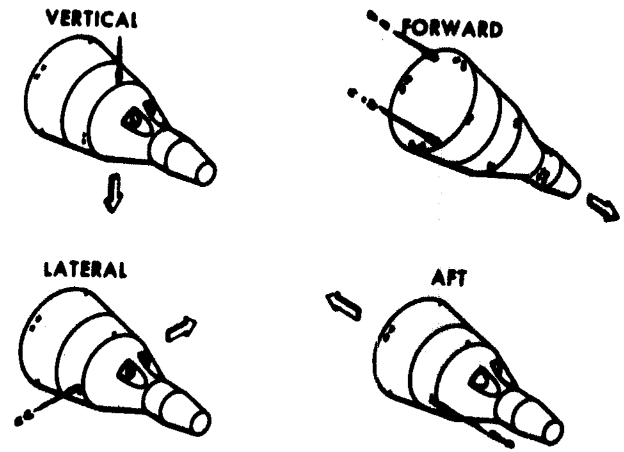
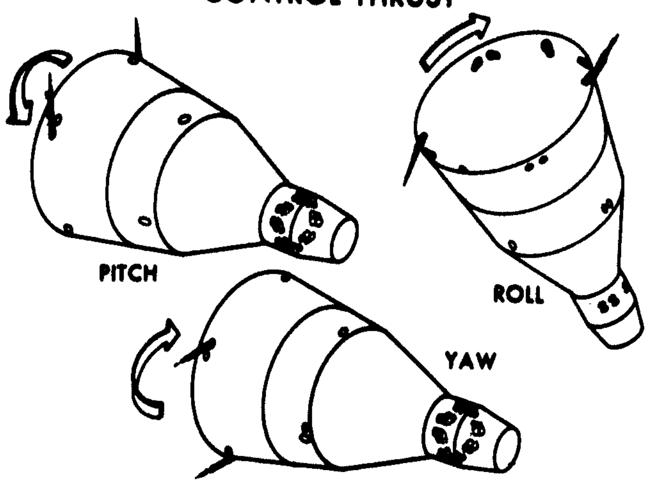
THRUST CHAMBER ARRANGEMENT



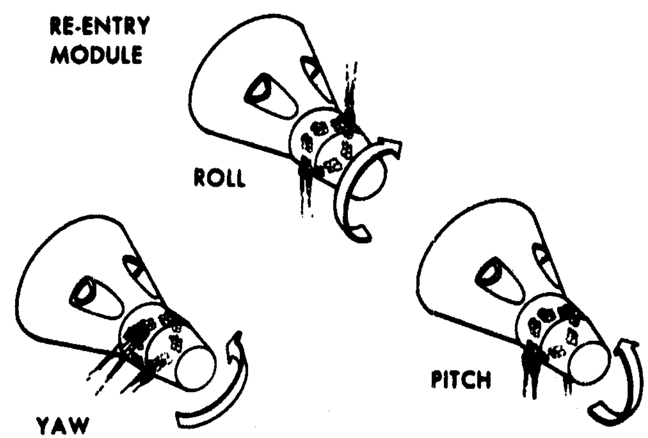
MANEUVERING CONTROL



SPACECRAFT RESPONSES TO ORBIT ATTITUDE CONTROL THRUST



RCS FUNCTION



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ELECTRICAL POWER SYSTEM

Gemini 9 will carry two fuel cells for the primary power supply during launch and orbit. The cells consist of three stacks of 32 individual cells. Cryogenic liquid oxygen and hydrogen are used as reactants to produce electrical energy through combination of the hydrogen and oxygen in a controlled reaction to produce water as a by-product.

Four 45 amp/hour batteries will also be carried in the spacecraft to insure a continuous power supply during reentry and landing. They will also be used during prelaunch and launch, in conjunction with the fuel cells.

Three 15 amp/hour squib batteries will be used in the reentry section for all squib-actuated pyrotechnic separating during the mission.

PROPELLANT

Total Useable -- 697 pounds

Mission Propellant budget with No Dispersions -- 623 pounds

RENDEZVOUS RADAR

Purpose -- Enables crew to measure range, range rate, and bearing angle to Agena. Supplies data to Inertial Guidance System computer so crew can determine maneuvers necessary for rendezvous.

Operation -- Transponder on Agena receives radar impulses and returns them to spacecraft at a specific frequency and pulse width. Radar accepts only signals processed by transponder.

Location -- small end of spacecraft on forward face of rendezvous and recovery section.

Size -- less than two cubic feet.

Weight -- less than 70 pounds.

Power Requirement -- less than 80 watts.

Auxiliary Tape Memory (ATM) -- The Auxiliary Tape Memory is a 15-track magnetic tape recorder which stores 835,000 bits on each track resulting in a total storage of 12,500,000 bits. Data parity, clocking, and computer processing bits are recorded in triplicate. The ATM provides triple redundant storage for approximately 1,170,000 bits that can be used for external storage of computer programs. The present computer has provided onboard computer program capability for launch, rendezvous, and reentry and has 156,000 bits of program storage.

The ATM is a hermetically-sealed unit which contains a mechanical transport assembly mounted on vibration isolators, and an electronic assembly containing the power supply, control logic, record logic, and playback logic.

The tape transport is a flangeless reel, peripheral drive unit which contains 525 feet of one-inch wide magnetic tape. The magnetic tape is driven by an endless, seamless 3/4-inch wide mylar belt called the peripheral drive belt. The peripheral drive belt is in turn driven by two drive capstans which are coupled by smaller endless, seamless mylar belts. By not exposing the magnetic tape to drive stresses, its useful life is extended.

The unit weighs 26 pounds, contains 700 cubic inches, and uses approximately 18 watts. The ATM is built by Raymond Engineering Laboratories, Middletown, Conn., under contract to the International Business Machines, Electronics Systems Division, Owego, N.Y., for the prime Gemini contractor, McDonnell Aircraft Corp.

GEMINI LAUNCH VEHICLE

The Gemini Launch Vehicle (GLV-9) is a modified U. S. Air Force Titan II intercontinental ballistic missile consisting of two stages, identical to the launch vehicles used in previous Gemini flights.

	FIRST STAGE	SECOND STAGE
HEIGHT	63 feet	27 feet
DIAMETER	10 feet	10 feet
THRUST	430,000 pounds (two engines)	100,000 pounds (one engine)
FUEL	50-50 blend of monomethyl hydrazine and unsymmetrical-dimethyl hydrazine	
OXIDIZER	Nitrogen tetroxide (Fuel is hypergolic, ignites spontaneously upon contact with oxidizer.)	

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Overall height of launch vehicle and spacecraft is 109 feet. Combined weight is about 340,000 pounds.

Modifications to Titan II for use as the Gemini Launch Vehicle include: (NOTE: GLV 9 same as GLV 1 through 8)

1. Malfunction detection system added to detect and transmit booster performance information to the crew.

2. Back-up flight control system added to provide a secondary system if primary system fails.

3. Radio guidance substituted for inertial guidance.

4. Retro and vernier rockets deleted.

5. New second stage equipment truss added.

6. New second stage forward oxidizer skirt assembly added.

7. Trajectory tracking requirements simplified.

8. Electrical hydraulic and instrument systems modified.

Gemini Launch Vehicle program management for NASA is under the direction of the Space Systems Division of the Air Force System Command.

AGENA TARGET VEHICLE

The Agena target vehicle for Gemini 9 is a modification of the U. S. Air Force Agena D upper stage, similar to the space vehicles which helped propel Ranger and Mariner spacecraft to the Moon and planets.

It acts as a separate stage of the Atlas/Agena launch vehicle, placing itself into orbit with its main propulsion, and can be maneuvered either by ground control or the Gemini 9 crew, using two propulsion systems.

Height (Liftoff)	36.3 feet	Including shroud
Length (orbit)	26 feet	Minus shroud and adapter
Diameter	5 feet	
Weight	7,000 pounds	In orbit, fueled
Thrust	16,000 pounds 400 pounds 32 pounds	Primary Propulsion Secondary Engines, Unit II Secondary Engines, Unit I
Fuel	UDMH (Unsymmetrical Dimethyl Hydrazine)	
Oxidizer	IRFNA (Inhibited Red Fuming Nitric Acid) in primary propulsion system; MON (Mixed Oxides of Nitrogen) in secondary propulsion system	
Combustion	IRFNA and UDMH are hypergolic, ignite on contact	

Primary and secondary propulsion systems are restartable. Main engine places Agena into orbit and is used for large orbit changes. Secondary system, two 200-pound-thrust, aft-firing engines, are for small velocity changes. Two 16-pound-thrust, aft-firing thrusters are for ullage orientation and vernier adjustments. Attitude control (roll, pitch, yaw) is accomplished by six nitrogen jets mounted on Agena aft end.

Modifications to Agena for use as Gemini rendezvous spacecraft include:

1. Docking collar and equipment to permit mechanical connection with Gemini during flight.

2. Radar transponder compatible with Gemini radar.

3. Displays and instrumentation, plus strobe lights for visually locating and inspecting Agena before docking.

4. Secondary propulsion system for small orbital changes.

5. Auxiliary equipment rack for special rendezvous equipment and telemetry.

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6. Command control equipment to allow control by Gemini 9 crew or ground controllers.

7. Multi-restartable engine to provide in-orbit maneuver capability.

Agena program management for NASA is under the direction of the Space Systems Division of the Air Force Systems Command.

STATIC CHARGE DEVICE

Experiments on Gemini 4 and 5 indicated there is no problem of a static charge between the spacecraft and the Agena during docking, but these experiments cannot be considered conclusive. Therefore, three protruding flexible copper fingers are installed on the Agena docking cone to make first contact with the spacecraft. Any charge will be carried to a ground in the Agena and dissipated at a controlled rate. An electrostatic charge monitoring device is also installed in the target docking adapter to measure the potential or difference in charge between the two vehicles.

ATLAS LAUNCH VEHICLE

The Atlas Standard Launch Vehicle is a refinement of the modified U.S. Air Force Atlas intercontinental ballistic missile, similar to the launch vehicle which placed Project Mercury Astronauts into orbit.

Atlas is a $1\frac{1}{2}$ stage vehicle, igniting all three main engines on the pad, then dropping off the two outboard booster engines at staging, allowing the single sustainer engine to continue thrusting at altitude, aided by two small vernier engines.

Height	77 Feet	Minus Agena Payload
Diameter	16 Feet	Lower Booster Section
	10 Feet	Tank Sections
	5 Feet, 10 inches	Tapered Upper End
Weight	260,000 pounds	Fully fueled, minus Agena payload
Thrust	390,000 pounds	Total at liftoff
	330,000 pounds	Two booster (outer) engines
	57,000 pounds	One Sustainer (center) engine

	Balance	Two small vernier engines for trajectory and final velocity control
Fuel	RP-1, a hydrocarbon resembling kerosene	
Oxidizer	Liquid oxygen at - 297 degrees F.	
Combustion	Unlike Titan's hypergolic, spontaneous ignition, Atlas combustion is achieved by forcing propellants to chambers under pressure, burning them in gas generators which drive propellant pump turbines.	

Modifications to the Atlas Standard Launch Vehicle for the Gemini 9 mission include:

1. Special autopilot system for rendezvous mission.

2. Improved propellant utilization system to assure simultaneous depletion of both fuel oxidizers.

3. Increased thickness of Atlas structure for support of Agena upper stage.

4. Simplified pneumatic system.

5. Retrorockets moved from exterior equipment pods to upper interstage adapter section.

6. Uprated MA-5 propulsion system (used on later Mercury flights.)

7. Modular telemetry kit tailored for each mission.

Atlas Standard Launch Vehicle program management for NASA is under the direction of the Space Systems Division of the Air Force Systems Command.

BIOGRAPHIES AND CONTRACTORS

COMMAND PILOT

NAME: Thomas Patten Stafford

BIRTHPLACE AND DATE: Weatherford, Oklahoma, September 17, 1930

EDUCATION: Bachelor of Science degree from United States Naval Academy in 1952

MARITAL STATUS: Married to the former Faye L. Shoemaker of Weatherford, Oklahoma

CHILDREN: Dianne, July 2, 1954; Karin, August 28, 1957

EXPERIENCE: Stafford, an Air Force lieutenant colonel, was commissioned in the United States Air Force upon graduation from Annapolis.

Following his flight training, he flew fighter interceptor aircraft in the United States and Germany, and later attended the USAF Experimental Flight Test School at Edwards AFB, California.

He served as chief of the Performance Branch, USAF Aerospace Research Pilot School at Edwards. In this assignment he was responsible for supervision and administration of the flying curriculum for student test pilots. He also served as an instructor in both flight test training and specialized academic subjects. He established basic textbooks and participated in and directed the writing of flight test manuals for use by the staff and students.

Stafford is co-author of the <u>Pilot's Handbook for Performance Flight Testing</u> and the <u>Aerodynamics Handbook for Performance Flight Testing.</u>

He was the pilot on the backup crew for the Gemini 3 flight, and pilot on the Gemini 6 flight, the first space rendezvous mission.

He has logged more than 4,500 hours flying time, including more than 3,800 hours in jet aircraft.

STAFFORD BIOGRAPHY (Continued)

Stafford was one of the nine astronauts named by NASA in September 1962. In addition to participating in the overall phases of astronaut training program, he has added specific assignments including monitoring design and development of communications and instrumentation systems, insuring that on-board systems are compatible with pilot needs and properly integrated with Mission Control Center systems, the ground operational support system and other communication links.

PILOT

NAME: Eugene Andrew Cernan

BIRTHPLACE AND DATE: Chicago, Illinois, March 14, 1934

EDUCATION: Bachelor of Science degree in electrical engineering from Purdue University, 1956; Master of Science degree in aeronautical engineering from United States Naval Postgraduate School at Monterey, Calif.

MARITAL STATUS: Married to the former Barbara J. Atchley of Houston, Texas

CHILDREN: Teresa Dawn, March 4, 1963

PROFESSIONAL ORGANIZATIONS: Member of Tau Beta Pi, national engineering society; Sigma Xi, national science research society; and Phi Gamma Delta

EXPERIENCE: Cernan, a United States Navy lieutenant commander, received his commission through the Navy ROTC program at Purdue, and entered flight training upon his graduation.

Prior to attending the Naval Postgraduate School he was assigned to Attack Squadrons 126 and 113 at the Miramar, California, Naval Air Station.

He has logged more than 1,900 hours flying time with more than 1,700 of that time in jet aircraft.

Cernan was named as one of the third group of astronauts, selected by NASA in October 1963. In addition to his participation in the astronaut training program, he has monitored the spacecraft propulsion systems and the Agena D (Gemini target vehicle), and has served as spacecraft communicator in the Mission Control Center on several previous Gemini flights.

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BACKUP COMMAND PILOT

NAME: James Arthur Lovell, Jr.

BIRTHPLACE AND DATE: Cleveland, Ohio, March 25, 1928

EDUCATION: Bachelor of Science degree from the United States Naval Academy in 1952

MARITAL STATUS: Married to the former Marilyn Gerlach of Milwaukee, Wisconsin

CHILDREN: Barbara L., October 13, 1953; James A., February 15, 1955; Susan K., July 14, 1958, Jeffrey, January 14, 1966

EXPERIENCE: Lovell, a Navy captain, received flight training following his graduation from Annapolis.

He served in a number of naval aviator assignments including a three-year tour as a test pilot at the Naval Air Test Center at Patuxent River, Md. His duties there included service as program manager for the F4H weapon system evaluation.

Lovell was graduated from the Aviation Safety School of the University of Southern California.

He served as flight instructor and safety officer with Fighter Squadron 101 at the Naval Air Station, Oceana, Virginia.

He was the pilot on the backup crew for the Gemini 4 manned flight and pilot on the Gemini 7 mission, spending two weeks in space, the current U. S. endurance record for manned flight. Before assignment to Gemini 9, Lovell was backup command pilot for Gemini 10.

Lovell has logged 3,300 hours flying time, including more than 2,200 hours in jet aircraft.

Lovell was selected as an astronaut by NASA in September 1962. In addition to participating in the overall astronaut training program, he was assigned special duties. These duties included monitoring design and development of recovery and crew life support systems. These include space suits, environmental control system and developing techniques for lunar and earth landings and recovery.

BACKUP PILOT

NAME: Edwin Eugene Aldrin, Jr.

BIRTHPLACE AND DATE: Montclair, New Jersey, January 20, 1930

EDUCATION: Bachelor of Science degree from the Military Academy, West Point, New York, 1951; and Doctor of Science degree in astronautics from Massachusetts Institute of Technology in 1963.

MARITAL STATUS: Married to the former Joan A. Archer of Ho-Ho-Kus, New Jersey

CHILDREN: James M., September 2, 1955, Janice R., August 16, 1957; Andrew J., June 17, 1958

SPECIAL AWARDS: Distinguished Flying Cross, and the Air Medal with two oak leaf clusters.

PROFESSIONAL SOCIETIES: Member, American Institute of Aeronautics and Astronautics; Sigma Gamma Tau, aeronautical engineering society; Tau Beta Pi, national engineering society; and Sigma Xi, national science research society.

EXPERIENCE: Aldrin, an Air Force major, received his wings at Bryan, Texas in 1952.

He flew 66 combat missions in F-86 combat aircraft in Korea with the 51st Fighter Interceptor Wing. Aldrin was credited with two MIG-15 aircraft destroyed and one damaged.

He served a tour as an aerial gunnery instructor at Nellis AFB, Nevada; then attended the Squadron Officers' School at the Air University, Maxwell AFB, Alabama.

Following a tour as administrative assistant to the Dean of Faculty, United States Air Force Academy, Aldrin flew F-100 aircraft as a flight commander with the 36th Tactical Fighter Wing at Bitburg, Germany.

After completion of his work at MIT, where his doctoral thesis concerned guidance for manned orbital rendezvous, he was assigned to the Gemini Target Office of the Air Force Space Systems Division, Los Angeles, California.

ALDRIN BIOGRAPHY (Continued)

While there he was a member of the special study group which made recommendations concerning Air Force participation in the NASA Gemini Program. He was later transferred to the USAF Field Office at the Manned Spacecraft Center which is charged with the responsibility of integrating DOD experiments into the NASA Gemini flights.

Aldrin has logged approximately 2,700 hours flying time, including 2,300 hours in jet aircraft.

Aldrin was one of the third group of astronauts named by NASA in October 1963. In addition to participating in the overall astronaut training program, his specific area of responsibility involves mission flight planning for both the Gemini and Apollo flights. He has played a key role in the formulation of mission profiles for the early Gemini rendezvous flights, and has been in charge of operations and training in the Astronaut Office. Before assignment to Gemini 9, he was back-up pilot on the Gemini 10 mission.

PREVIOUS GEMINI FLIGHTS

Gemini 1, Apr. 8, 1964

Unmanned orbital flight, using first production spacecraft, to test Gemini launch vehicle performance and ability of launch vehicle and spacecraft to withstand launch environment. Spacecraft and second stage launch vehicle orbited for about four days. No recovery attempted.

Gemini 2, Jan. 19, 1965

Unmanned ballistic flight to qualify spacecraft reentry heat protection and spacecraft systems. Delayed three times by adverse weather, including hurricanes Cleo and Dora. December launch attempt terminated after malfunction detection system shut engines down because of hydraulic component failure. Spacecraft recovered after ballistic reentry over Atlantic Ocean.

Gemini 3, Mar. 23, 1965

First manned flight, with Astronauts Virgil I. Grissom and John W. Young as crew. Orbited Earth three times in four hours, 53 minutes. Landed about 50 miles short of planned landing area in Atlantic because spacecraft did not provide expected lift during reentry. First manned spacecraft to maneuver out of plane, alter its own orbit. Grissom, who made suborbital Mercury flight, is first man to fly into space twice.

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Gemini 4, June 3-7, 1965

Second manned Gemini flight completed 62 revolutions and landed in primary Atlantic recovery area after 97 hours, 56 minutes of flight. Astronaut James A. McDivitt was command pilot. Astronaut Edward H. White II was pilot, accomplished 21 minutes of Extravehicular Activity (EVA), using a hand held maneuvering unit for first time in space. Near-rendezvous with GLV second stage was not accomplished after use of pre-planned amount of fuel for the maneuver. Malfunction in Inertial Guidance System required crew to perform zero-lift reentry.

Gemini 5, Aug. 21-29, 1965

Astronauts L. Gordon Cooper and Charles (Pete) Conrad, Jr., circled the Earth 120 times in seven days, 22 hours and 56 minutes. Cooper was first to make two orbital space flights. Failure of oxygen heating system in fuel cell supply system threatened mission during first day of flight, but careful use of electrical power, and excellent operational management of fuel cells by both crew and ground personnel, permitted crew to complete flight successfully. Spacecraft landed about 100 miles from primary Atlantic recovery vessel because of erroneous base-line information programmed into onboard computer, although computer itself performed as planned. Plan to rendezvous with a transponder-bearing pod carried aloft by Gemini 5 was cancelled because of problem with fuel cell oxygen supply.

Gemini 7, Dec. 4-18, 1965

Holds current world record for manned space flight as Command Pilot Frank Borman and Pilot James Lovell completed 206 revolutions of the earth in 13 days, 18 hours, and 35 minutes. On the 12th day of their flight, the Gemini 7 served as target for the Gemini 6 spacecraft on the first successful rendezvous in space. In proving man's ability to operate in space for period up to two weeks, the crew of Gemini 7 carried out an ambitious list of 20 experiments including all medical experiments in the Gemini program, a test of laser communications from space, and visual acuity. The Gemini 7 experienced continuous difficulty with the delta p light on the fuel cell system. However, the system performed for the entire mission. The only other problem encountered was the temporary malfunction of a yaw thruster on the spacecraft. Gemini 7 landed in the Atlantic on Dec. 18, making a controlled reentry which brought it within 10 miles of the recovery carrier.

Gemini 6, Dec. 15-16, 1965

The first spacecraft to rendezvous with another spacecraft in orbit. Command pilot Walter Schirra and Pilot Thomas Stafford flew their spacecraft from a 100-by-167 mile orbit into a 185-mile circular orbit, rendezvousing with Gemini 7 over the Pacific Ocean at 5 hrs. 47 min. after liftoff. It demonstrated one of the major objectives of the program, and also paved the way for Apollo Lunar Orbit Rendezvous in the accomplishment of the first manned landing on the Moon.

Gemini 6 was launched on its historic rendezvous mission on the third attempt. On the first try, Oct. 25, the Agena Target Vehicle was destroyed by a hard start of its primary propulsion system. On Dec. 12, the Gemini Launch Vehicle failed to achieve liftoff when an electrical plug connecting the rocket with the pad electrical system dropped out prematurely.

Gemini 8, March 16, 1966

Astronaut Neil Armstrong, command pilot, and David Scott, pilot, completed the first rendezvous and docking with an Agena spacecraft launched into orbit approximately 100 minutes earlier. The planned three-day flight was terminated near the end of the sixth revolution after an electrical short circuit in the Gemini spacecraft caused continuous firing of a roll thruster. The crew undocked from the Agena and activated the reentry reaction control system to regain control of the spacecraft. The crew made a guided reentry and landed in the Pacific Ocean 500 miles east of the island of Okinawa, and only approximately five miles from the aiming point for the most accurate landing by a Gemini spacecraft. A recovery aircraft was on the scene before splashdown to parachute a recovery team to the spacecraft. The crew and spacecraft were picked up by a Navy destroyer approximately three hours after splashdown.

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U.S. MANNED SPACE FLIGHTS

MISSION	SPACECRAFT HRS.			REVS.	MANNED HOURS IN MISSION			TOTAL MANNED HRS CUMULATIVE		
	HRS.	MIN.	SEC.		HRS.	MIN.	SEC.	HRS.	MIN.	SEC.
MR-3 (Shepard)		15	22	S.O.		15	22		15	22
MR-4 (Grissom)		15	37	S.O.		15	37		30	59
MA-6 (Glenn)	4	55	23	3	4	55	23	5	26	22
MA-7 (Carpenter)	4	56	05	3	4	56	05	10	22	27
MA-8 (Schirra)	9	13	11	6	9	13	11	19	35	38
MA-9 (Cooper)	34	19	49	22	34	19	49	53	55	27
Gemini 3 (Grissom & Young)	4	53	00	3	9	46	00	63	41	27
Gemini 4 (McDivitt & White)	97	56	11	62	195	52	22	259	33	49
Gemini 5 (Cooper & Conrad)	190	56	01	120	381	52	02	641	25	51
Gemini 7 (Borman & Lovell)	330	35	13	206	661	10	26	1302	36	17
Gemini 6 (Schirra & Stafford)	25	51	24	15	51	42	48	1354	19	05
Gemini 8 (Armstrong & Scott)	10	42	06	6.6	21	24	12	1375	43	17

PROJECT OFFICIALS

Dr. George E. Mueller	Associate Administrator Office of Manned Space Flight, NASA Headquarters Acting Director, Gemini Program
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Maj. Gen. V. G. Huston	USAF, Deputy DOD Manager
Col. Robert R. Hull	Director, Directorate, Gemini Launch Vehicles, Space Systems Division, Air Force Systems Command
Col. John G. Albert	Chief, Gemini Launch Division, 6555th Aerospace Test Wing, Air Force Missile Test Center, Cape Kennedy, Fla.
R. Adm. Wm. C. Abhau	USN, Commander Task Force 140

SPACECRAFT CONTRACTORS

McDonnell Aircraft Corp., St. Louis, Mo., is prime contractor for the Gemini spacecraft. Others include:

AIResearch Manufacturing Co. Los Angeles, Calif.	Environmental Control System
The Eagle Pitcher Co. Joplin, Mo.	Batteries
General Electric Co. West Lynn, Mass.	Fuel Cells
Northrop Corp. Newbury Park, Calif.	Parachutes
Rocketdyne Canoga Park, Calif.	OAMS, RCS
Thiokol Chemical Corp. Elkton, Md.	Retrorocket System
Weber Aircraft Corp. Burbank, Calif.	Ejection Seats
Westinghouse Electric Corp. Baltimore, Md.	Rendezvous Radar System

Atlas contractors include:

General Dynamics, Convair Div., San Diego, Calif.	Airframe and Systems Integration
Rocketdyne Div., North American Aviation, Inc. Canoga Park, Calif.	Propulsion Systems
General Electric Co. Syracuse, New York	Guidance

Titan II contractors include:

Martin Co., Baltimore Division, Baltimore, Md.	Airframe and Systems Integration
Aerojet-General Corp. Sacramento, Calif.	Propulsion System
General Electric Co. Syracuse, N.Y.	Radio Command Guidance System
Burroughs Corp. Paoli, Pa.	Ground Guidance Computer
Aerospace Corp. El Segundo, Calif.	Systems Engineering and Technical Direction

Agena D contractors include:

Lockheed Missiles and Space Co., Sunnyvale, Calif.	Airframe and Systems Integration
Bell Aerosystems Co. Niagara Falls, N.Y.	Propulsion Systems
McDonnell Aircraft Co. St. Louis, Mo.	Target Docking Adapter

Food Contractors:

U.S. Army Laboratories Natick, Mass.	Food Formulation Concept
Whirlpool Corp. St. Joseph, Mich.	Procurement, Processing, Packaging
Swift and Co., Chicago and Pillsbury Co., Minneapolis	Principal Food Contractors

Suit Contractor:

The David R. Clark Co.
Worcester, Mass.

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ABBREVIATIONS AND SYMBOLS FREQUENTLY USED

AMU	Astronaut Maneuvering Unit
ASCO	Auxiliary Sustainer Cut Off
CGLVTC	Chief Gemini Launch Vehicle Test Conductor
ECS	Environmental Control System
ETR	Eastern Test Range
EVA	Extravehicular Activity
ELSS	Extravehicular Life Support System
FLT	Flight Director (Houston)
GAATV	Gemini Atlas Agena target vehicle
GATV	Gemini Agena target vehicle
GEN	General information
GLV	Gemini launch vehicle
GN2	Gaseous Nitrogen
GT	Gemini Titan
IMU	Inertial measuring unit
IRFNA	Inhibited Red Fuming Nitric Acid
LC (14)	Launch Conductor - Complex 14
LD (14)	Launch Director - Complex 14
LD (19)	Launch Director - Complex 19
LMD	Launch Mission Director
LN2	Liquid Nitrogen
LO2	Liquid Oxygen
LTC	Lockheed Test Conductor
MCC	Mission Control Center (Defined with the word Houston or Cape)
MD	Mission Director (Houston)
OAMS	Orbit Attitude Maneuvering System
PCM	Pulse Code Modulation
S/C	(Gemini) spacecraft
SPCFT	Chief Spacecraft test conductor
SLD	Simultaneous Launch Demonstration
SLV	Standard (Atlas) launch vehicle
STC	SLV test conductor
SRO	Superintendent of range operations
TDA	Target docking adapter
UDMH	Unsymmetrical Dimethlhydrazine

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